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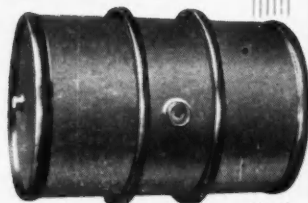
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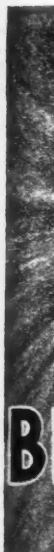
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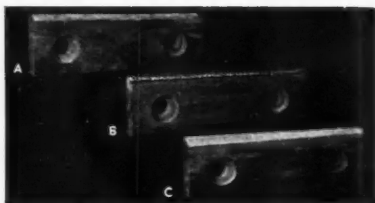
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COPPER—cable, electrical parts and fittings, sheathing, tube, turnings, wire.

ZINC—sheet, cuttings.

LEAD—covered cable, pipe, sheet, solder.

WHITE METAL—anti-friction metal, plumbers' jointings, solder waste.

BRASS—pipe, sheet, tube, turnings.

BRONZE—bearings, bushes, cocks, couplings, crown wheels, junction boxes, unions, valves.

ALUMINIUM SCRAP (and its alloys)—pipe, sheet, castings, tube, turnings.

HOW TO DISPOSE OF IT

1 Sell your non-ferrous scrap to a Merchant.

2 Or hand it in to a Local Authority Depot.

3 **SPECIAL COLLECTIONS** of amounts over ONE TON may be obtained by getting in touch with the nearest Demolition and Recovery Officer. If you don't know his name, write to The Ministry of Works & Planning, Lambeth Bridge House, London, S.E.1.

NOTE: Under the provisions of the Scrap Metal (No. 2) Order, 1942, if you are in possession of more than 3 tons of Scrap Metal, it is now an offence not to disclose the fact to The Ministry of Works & Planning, Lambeth Bridge House, London, S.E.1.

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Is Patent Law Sound?

PATENTS have their origin deep in the history of our country. Charters or patents were granted to trade guilds from the earliest times, and from the beginning of the 14th century to the middle of the 15th century letters of protection of various kinds were given to foreign weavers and craftsmen in order to promote the establishment of the new trades they brought with them. It was, however, not until the 17th century that patents as we know them to-day and as distinct from exclusive privileges or monopolies were set up, and it was about the year 1600 that the courts of law began to draw a sharp distinction between a monopoly valid because its holder had made an invention in introducing a new trade, and an invalid monopoly which restrained a trade by giving to a limited number of persons the sole right of engaging in it. Thus patent law has its roots in events that occurred some 300 or 400 years ago and has grown steadily from those early beginnings.

It has not escaped the notice of reformers that patents have changed their position in the intervening centuries and have now become tools in the hands of big business. The change is a fundamental one based on a change in business

methods. In the 17th century an invention could be readily exploited by a small concern which enabled its promoters to reap adequate profit within a comparatively short space of time, and in so doing to gain experience which in practice retained something of a monopoly over several more years. This state of affairs continued until great corporations began to engage in research on a huge scale for the express purpose of keeping ahead of their competitors. The expenses of research are great, and in order that they may be secured, a development period of more than the normal life of a patent is frequently necessary. It is not therefore surprising that the system of "blocking patents" arose as part of a general legal technique designed to secure the best

possible financial advantage from the work of research laboratories and other development departments.

There have been many complaints that blocking patents are wrong in principle and demands that they be abolished. Before deciding too rashly that this complaint is justified, it is well to consider the essential purpose of a patent. The purpose to-day is probably similar to that of 300 or 400 years

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ago, namely, to encourage the development of new trades and new processes. There are many scientific men who engage in research work with purely altruistic objects and who have no thought of financial gain. They are on a plane by themselves, a plane approached by comparatively few. It was Pope who wrote:

"Shakespeare

For gain, not glory, winged his roving flight
And grew immortal in his own despite."

Business houses and financiers follow the Shakespearean lead.

It must not be forgotten that the invention of a patentable process is by no means the final nor even the most expensive part of what has to be done before the invention is placed on a commercial basis. A great deal of money must be spent in development, including (a) technical development, (b) market development, and (c) sales. There is a great deal of risk attached to the development of a new patent, and it is only natural for this risk not to be taken unless the rewards for success are adequate. It is natural that firms should take every precaution legally open to them to secure themselves against the manifestly unfair competition of a rival starting from the basis of an original discovery in which he has taken no part. Before blocking patents are condemned wholesale, and before there is any vital change in the technique of patent law, care must be taken that the rewards of patenting new processes or machinery will not be rendered too slight to promote research and its commercial exploitation.

In one direction, namely, the relative positions in regard to patent law for the small man and the big concern, there seem to be grounds for a careful consideration of the present patent position. So soon as the law is invoked expense begins to mount up alarmingly, so that firms with adequate financial resources behind them can always overlay the hand of the small man whose resources are limited. In this commercial age it seems that victory generally goes to the big battalions in one way or another, and if we desire to retain the individual freedom and the virility of small concerns, the scales should be balanced so that access to justice is not outweighed by gold. In this connection it is also necessary to consider whether the inter-

national patent laws do not unduly strengthen the business interests of foreign countries at the expense of home trade.

There are many safeguards against abuse of monopoly rights by the patentee which are set out in Section 27 of the Patents and Designs Act of 1907 as amended in 1938. These are: (a) Non-working of the invention within the United Kingdom on a commercial scale without satisfactory reasons; (b) non-working of the invention owing to the importation by the patentee of the article from abroad; (c) inadequate working of the invention so that the demand for the article is not adequately met on reasonable terms; (d) prejudice of trade or industry by the refusal of the patentee to grant licences upon reasonable terms; (e) prejudice of trade or industry by the attachment of restrictive conditions to the use of the article; (f) use of the patent to prevent materials not covered by it from being used freely in industry.

It has been suggested further that the best approach for strengthening the hands of the Comptroller, if such strengthening were found to be necessary, would be along the lines of the procedure already set out in Section 38 (a) of the 1907 Act. This Section provides that the Comptroller, unless he sees good reason to the contrary, shall grant to any applicant a licence limited to the use of a preparation or production of food or medicine. The Comptroller can furthermore fix the terms of the licence and the amount of royalty, and in doing so he must have regard to the desirability of making the food or medicine available to the public at the lowest possible price consistent with giving to the inventor due reward for the research leading to the invention. If licences were granted on these lines to any applicant for a patent in any field the restrictive use for blocking patents could be overcome without at the same time preventing the patentee from securing some benefit from his invention. One of the essential difficulties of remodelling patent law is to maintain a free flow of information and to prevent that secrecy in regard to discoveries and practices which is well-known to be a brake upon progress.

NOTES AND COMMENTS

Censorship Ethics

REGULATIONS covering the censorship of the technical Press in this country are remarkably liberal, all things considered. Mention of important new discoveries affecting the weapons of war must obviously not be made, and details of the location and construction of new factories, if revealed, would certainly be of direct use to the enemy. But undoubtedly information is published in our scientific journals that must be of use to the enemy, as it is to everyone else, but on which no censorship is imposed. Some idea of how much more we might be censored may be gained from a note in the *New York Times*. That journal adversely criticises the action of the U.S. censorship in prohibiting the publication of an article describing a new sulphonamide which can be effective against, e.g., dysentery, on the grounds that it could be of use to the enemy. Another prohibited subject was a new spray treatment of mine-walls to check mercury poisoning. Evidently a point of ethics is involved, or at any rate of humanitarianism. We are inclined to agree that our own censorship is right in implicitly following the precept that its duty is to stop the circulation of information that might assist the enemy in his war against us rather than to kill news of the campaign against the foes of mankind in general.

Chemical Industry in Scotland

LORD MCGOWAN stated in a résumé of potential post-war development in Scotland that his company were considerably extending their plant for the production of pharmaceuticals. He stressed the possibilities of the development of hydro-electric power. Instancing possible industrial chemical developments, Lord McGowan pointed out that cheap carbide would almost automatically open up a field which included the manufacture of plastics and solvents. Other possibilities were pharmaceuticals and ferro-alloys, and, given a development of hydro-electric power, he could see no reason why substantial plants for their manufacture should not be located in Scotland. Before the war Britain imported from 20,000-30,000 tons of ferro-silicon annually and from 10,000-20,000

tons of ferrochrome. Whether Scotland could have a share in producing these depended on how far she could develop her hydro-electric power.

New Scottish Undertakings

THE speech just quoted was delivered in Edinburgh at a meeting of the Scottish Council of Industry. A review of the achievements of the Council during the nine months of its existence was given by the chairman, Lord Provost William Y. Darling. The progress report revealed that since the beginning of the present year 119 units of new production have been located in districts throughout Scotland. Of these 119 units, Lord Provost Darling said that approximately half were completely new undertakings or extensions, the remainder being existing manufacturing units converted to new production. The employment capacity of these new and converted factories when they reached maximum production was estimated at 20,000-25,000 workers.

New Materials for Housing

MR. ALFRED BOSSOM, F.R.I.B.A., M.P., recently urged that attention be paid to research in house-building now. He called for the attention of modern science to the problem and advocated pre-fabrication wherever possible. The principles of Mr. Henry J. Kaiser, the American ship-builder must, he thought, be adopted in the building industry. He advised the combination of plastics and timber and wanted consideration of concretes, sawdusts, cements, pressed cork, cast glass and slab rubberoids. Before this war began there was a movement towards the employment of more wood as the chief material in building and some very successful attempts in design and construction were made. Now Mr. Bossom advocates a resumption of this tendency, asking: "Why not have many houses of wood after the manner of the delightful American colonial architecture?"

Co-operation Among Experts

IF the housing problem is to be tackled on a national scale after the war it is essential that the best use be made of the materials available. They will not be

too plentiful for an adequate construction programme. But that is not all. Speed will be a vital factor and the question of selecting the right materials for rapid erection of houses is occupying the attention of builders and architects. It is important, too, that a more vigorous and independent approach to design in the construction of homes than hitherto be made, for no one with any social sense wants to see the resumption of "pandemonium" building with its borrowing of the styles of half-a-dozen periods in the construction of one house. We have many new materials which demand a style of their own. In the exhibition: "The Englishman Builds" now open at the National Gallery, London, more than a hint is given of the uses to which they can be put in the development of a suitable style for a new age. The bad building of the last decade or two has been due largely to the reluctance—or lack of opportunity—of the experts to get together. What can be achieved when they do get together is exemplified in the design of motor cars—and later aeroplanes—where every detail in appearance, comfort and utility has been studied to such good effect that it would be difficult to say with certainty which of the three motives lay behind any particular feature.

South Africa's Gold Mines

SOUTH Africa is getting increasingly self-conscious about her gold mining activities following the closing of United States and Canadian mines and the transfer of workers into war industries. Washington has found a rich source of labour for base-metal mines in this way and critics of the Union Government have suggested that South Africa might follow suit. Against this it is insisted that gold production does not interfere with the labour supply for the production of other minerals. The expansion of base metal mining is progressing satisfactorily, it is said, and the United States mission which was recently in South Africa has placed orders for chrome, manganese, asbestos, copper, vanadium, and some other minerals. The *South African Mining and Engineering Journal* stigmatises as "misguided" the opinion of many that by closing down the gold mines South Africa could intensify her war effort.

Base Metal Industry

IT is alleged that the closure of the mines would mean the throwing out of employment of some 35,000 Europeans and more than ten times that number of natives. It would be difficult to absorb so many men quickly into the Army. "Alternative employment," says the journal, "would, it is suggested, be in base metal enterprises. Where, it may be asked, are these tremendous enterprises to be found? It would not require any great increase in the labour force if manganese and chrome ore production were to be doubled, even trebled; but, when all known facts and factors are considered, we feel constrained to question whether the United Nations really want (or are in a position to handle) double or treble the output of those minerals." We can see nothing in these arguments to justify a maintenance of the South African gold mining industry in its present form. At a time when the Nazis are enslaving most of Europe to supplement their own industrial war effort, the absorption of something like 400,000 workers in the Allied cause should present no difficulties.

Travelling Laboratory

TO say that the chemist is becoming more important to the gas industry would be misleading. He has always been important to the gas industry. But to a growing extent the vital part that he can play in the production of this fuel and the by-products of its manufacture is being recognised. The responsible work of watching the calorific value of the gas itself in order to ensure the maintenance of a high-quality fuel, as well as the specialised job of preserving and developing valuable by-products, has too often been left to men with less than the desired qualifications. In war this problem becomes one of urgency. At a time when the chemical products of coal are a vital war material, some gasworks are being left without even the technical assistants they had, owing to the call-up. One way in which the difficulty can be overcome is by the travelling laboratory. A scheme is being inaugurated in the Midlands which will enable gasworks that are understaffed with chemists to have the services of fully qualified men "on tap." It is an innovation with great potentialities.

Terpene Chemicals

Some New Developments Outlined

THE chemical separation of steam-distilled pine oil into its principal components anethole, camphor, fenchone, and terpineol, as well as the production of terpene resins, are among the new developments in terpene chemistry described in an interesting article by Robert C. Palmer, of Newport Industries, Inc., Pensacola, Florida (*Ind. Eng. Chem.*, 1942, 34, 9, p. 1028).

In the commercial separation of pine-oil constituents, the tertiary alcohols are separated either as the α -terpineol or as the mixed alpha and other isomeric terpineols which have the fine floral essence that makes it of special value as a perfume base. Terpineol can be obtained by fractional crystallisation (melting point, 35° C.), but to obtain the perfume grade known as β -terpineol on a commercial scale the complete hydration of the tertiary alcohol naturally present in the pine oil must be carried out under carefully controlled conditions. Sulphuric acid is used as the catalyst. After the acid is removed, all the pine oil not reacted on is separated from the terpinol hydrate by steam distillation; care must be taken to keep the pH on the alkaline side during steaming. The conditions are then changed to the acid side, and the terpinol is dehydrated to a crude terpineol which is then carefully refined by severe fractional distillation over caustic alkali under very high vacuum. This yields the commercial β -terpineol.

Anethole

The portion unaffected by hydration, which has been steam-distilled from the terpinol, is then treated with concentrated caustic at temperature conditions that will isomerise the phenol ether, methylchavicol, to its useful isomer, anethole. The boiling point of the ether is so close to that of some alcohols that it cannot be isolated by fractional distillation, but its isomer, anethole, boils at about 18° C. higher and can, therefore, be easily separated in that way. The crude anethole is chemically treated to ensure the absence of phenols and is then redistilled under high vacuum to give the refined product. Anethole has an extremely sweet liquorice taste and is widely used as a flavour in confections and in tobacco.

The treatment so far described has in no way injured the two remaining components of the original pine oil that are of any commercial importance. These are the secondary alcohols, fenchol and borneol, which will have been recovered as a cut in the fractional distillation of anethole. They are, however, of value only as potential

sources of their corresponding ketones. The next step in the process is their oxidation which is carried out as a liquid-phase atmospheric-pressure catalytic dehydrogenation. This is accomplished by boiling the oil under reflux with about 2 per cent. by weight of nickel, or copper carbonate, or a mixture of the two, for several hours.

The reaction must be and is 100 per cent. of theoretical, since the secondary alcohols cannot be separated from the ketones by distillation. After the hydrogen is removed, the oil is distilled again under high vacuum, and pure fenchone is separated as the lower boiling fraction. The camphor cut may be somewhat less pure, as camphor is readily and finally purified to its U.S.P. specification melting-point by fractional crystallisation from alcohol. The camphor produced in this way from pine oil has a positive optical rotation, while synthetic camphor from pinene is optically inactive. The most probable cause of this difference is the presence of some natural camphor in pine oil which is recovered unchanged with the camphor synthesised from the borneol. The latest edition of the U.S. Pharmacopoeia modified its definition of synthetic camphor as regards the optical properties because of this peculiarity.

Terpene Resins

Commercial synthesis of pine oil from the pinenes was undertaken when the demand exceeded that being supplied from its normal sources, and pine oil made from turpentine is not a new development but has been made in substantial volume for several years, but a more recent development utilising bicyclic terpene hydrocarbons should be mentioned, as it may rank eventually with the leading chemical users of turpentine. It has long been known that the unsaturated character of the terpenes lends itself readily to polymerisation reactions as well as to condensations, but apart from a paragraph or so in such works as Ellis's *Chemistry of Synthetic Resins*, almost no mention is made of the possible formation of useful resins from terpenes. Such resins are now being made commercially and in rapidly increasing quantity. The processes are new and details have not been divulged.

Two types of resin are being made from terpenes. One is a substituted phenolic which, on condensation with formaldehyde, gives either thermosetting or thermoplastic resins of good melting point and excellent colour stability, depending on how the aldehyde reaction is conducted. The other type, which is the more recent development and has perhaps the greatest possibility of

growth, is a neutral hydrocarbon resin, obtained by catalytic polymerisation. These resins are available in a range of melting points and colour grades comparable to the coumarone resins, but the terpene products seem to have somewhat greater usefulness. They not only have satisfactory initial colour but good colour stability, and are soluble in a variety of solvents. Resins can be made from monocyclic terpene hydrocarbons as well as from bicyclic, but so far the pinenes seem to be preferred.

The relation of the $C_{10}H_{16}$ monocyclic terpene configuration to *p*-menthane, $C_{10}H_{20}$, and also to the aromatic benzoid $C_{10}H_{14}$, more commonly known as cymene, can be readily seen. There are several references in the chemical literature, to vapour-phase dehydrogenation of the monocyclic terpene hydrocarbons, limonene or dipentene, but for the most part the decomposition is not readily controlled. Losses as tar may be excessive or the dehydrogenation so incomplete that it is not possible to separate the cymene from unreacted terpenes without resorting to expensive additional steps. An entirely practicable method has now been developed, and any of the monocyclic terpene hydrocarbons may be used with equal success. The process consists in a liquid-phase catalytic disproportionation at atmospheric pressure with practically 100 per cent, theoretical yield.

The catalyst is copper-nickel formate with a metal ratio of three copper to one nickel, which is best prepared by reacting the metal carbonates with formic acid. The dried, powdered, mixed formate, equal to about 2 per cent, by weight of the oil, is gradually fed into the boiling terpene hydrocarbon connected to a reflux condenser and a water trap. About 8 hours are usually required to complete the reaction. For every three parts of starting terpenes there are produced two parts of cymene and one part of *p*-menthane. By careful vacuum fractionation these products can be completely separated. Two terpene chemicals are thus provided at sufficiently low cost and high purity to become interesting as raw materials for further processing.

Cymene Products

The conversion of cymene to its monobasic acid, toluic acid, by the oxidation of the isopropyl group is not new. The dibasic acid, terephthalic acid, involving the oxidation of the *p*-methyl as well as the isopropyl group, is also possible. It was an unexpected result to find that the *p*-methyl group could be exclusively and selectively oxidised to give the corresponding isopropyl-benzoic acid, cumic acid. A number of oxygen-containing compounds of many metals have been found to be satisfactory catalysts. A mixture of powdered dehydrated manganese and lead acetates gives good re-

sults. After 72 hours at 30° C. as much as 40 per cent, of the cymene reacted on may be converted to cumic acid. The acid is washed out of the reaction mass with alkali and then recovered by acid precipitation; refinement is conventional, such as by distillation and crystallisation from a solvent. Cumic acid can thus be readily obtained in technical purity. It is a colourless needle crystal (melting at 116° C.) and can be substituted for benzoic acid for a number of uses. It is believed that this homologue of benzoic acid will have a wider usefulness in organic reactions than toluic acid.

Another new product that will be made from cymene is a tertiary alcohol, dimethyltolyl carbinol; it is produced by the controlled catalytic liquid-phase oxygenation of the cymene. Except for the fact that the starting material has a benzene nucleus rather than a terpene, the product would be α -terpineol. The physical properties of this carbinol are quite different from those of terpineol. It has a high specific gravity (0.98 compared to 0.936 for terpineol) and a high index of refraction (1.52 compared to 1.485). The wetting properties are good. It has a pleasant odour and may readily be used as a substitute for pine oil wherever a high alcohol content is required. Its boiling range is about 10° C. higher than that of terpineol and it evinces a lack of stability when heated to its boiling point at atmospheric pressure.

An Interesting Hydrocarbon

The hydrocarbon produced when the alcohol is dehydrated is perhaps the most interesting chemical produced in this series of products. It is still unsaturated in the side chain, which becomes a methyl-substituted vinyl group. This hydrocarbon is, therefore, the *p*-methyl homologue of α -methylstyrene. A large-scale manufacture of this new chemical from terpenes is of considerable interest and is a noteworthy development for several reasons. The foremost of these became apparent when it was discovered during the course of these researches that the α -substituted styrenes, while not polymerisable alone by means of heat as are the vinylbenzenes themselves, are readily copolymerisable with the styrenes in molar proportions or less to yield colourless resins. Typical physical constants of *p*-methyl- α -methylstyrene are: sp. gr. at 15.5/4° C., 0.9038; index of refraction at 20° C., 1.5329; boiling range, 190-191° C.

After the dehydration step to produce *p*-methyl- α -methylstyrene and the separation of the hydrocarbon by fractional distillation, methylacetophenone remains as a residue and is recovered as one of the by-products. This ketone is widely used as a soap perfume and for other purposes. It is a colourless, high-boiling oil (b.p. about 225° C.,

sp. gr. slightly over 1.0). It should find numerous industrial uses. This material has not been available hitherto in any quantity but only as an expensive aromatic chemical. Methylacetophenone may be reduced to a secondary alcohol which, on dehydration, gives *p*-methylstyrene. This vinyltoluene has the same polymerising properties as styrene, which yields the tough colourless resins that are being developed with such rapidity to-day.

Menthane Products

The process of oxidising *cymene* is adaptable to the treatment of *p*-menthane with slight modification. The products are in each case the hexahydro modifications of the corresponding *cymene* derivatives. Hexahydrocumin and toluic acids are closely related to (in fact, are isomeric with) the naphthenic acids. The corresponding alcohol is dihydroterpineol. It has a pleasant odour and could no doubt be used for many of the same purposes as pine oil where a terpene alcohol is the important and desirable constituent. The saturated ketone has not been isolated or investigated. *p*-Menthane itself is also of commercial interest as

a solvent because of its extremely narrow boiling range and the fact that it is chemically saturated.

Allo-ocimene and perhaps myrcene, the two most interesting aliphatic hydrocarbons readily producible by rupturing the pinene ring, though not yet commercially produced, may become available as industrial chemicals. Their great interest lies in a triple unsaturation and, therefore, their adaptability to many reactions. Myrcene (from β -pinene) has one conjugated double linkage, and allo-ocimene (from α -pinene) has the unusual structure of two conjugated double bonds. Both are capable of the Diels-Alder reaction with maleic anhydride, which makes possible a large number of complex esters. This interesting field has not yet been explored.

Allo-ocimene readily polymerises by oxidation to a dry resinous film without the aid of a catalyst. In the presence of a little ordinary varnish oil drier, the drying characteristics are rapid. The film retains moderate flexibility for some time but finally becomes brittle. Numerous other uses for these unusual terpenes of even greater interest seem possible.

Decimal Classification

New Edition in Hand

WE would direct the attention of those of our readers concerned with the abstracting of scientific and technical literature, etc., to the fact that the following parts of the English Edition of the Universal Decimal Classification, all stocks of which were destroyed by enemy action, are being reprinted by the British Standards Institution.

- | | | |
|-----------------|----------------------------|------------------|
| Vol 1, Part 1. | General | Introduction. |
| | Auxiliary Tables and Class | O, Generalities. |
| Vol. 2, Part 1. | Classes 51, | Mathematics. |
| | 52, | Astronomy. |
| | 53, | Physics. |
| Vol. 2, Part 2. | Class 54, | Chemistry. |
| Vol. 2, Part 3. | Classes 55, | Geology and |
| | | Geophysics. |
| | 56, | Palaeontology. |
| | 57, | Biology. |
| | 58, | Botany. |
| | 59, | Zoology. |

Vol. 1, Part 1 will be published at 7s. 6d. and Vol. 2, Parts 1, 2 and 3 at 10s. each.

Owing to the restrictions imposed by the Paper Controller, the edition will be strictly limited, and the B.S.I. is desirous of ascertaining the probable extent of the demand for the various parts. All orders will be dealt with in rotation, and should be addressed to the Publications Department, British Standards Institution, 28 Victoria Street, London, S.W.1.

Atomic Structure and War

Sir Lawrence Bragg on Metals

SIR LAWRENCE BRAGG, F.R.S., Director of the Cavendish Laboratory, Cambridge, lectured at Manchester University recently for the Manchester Literary and Philosophical Society on "Metals." He said that the possibility of using metals for machinery, and thus the mechanical war and the whole of our mechanical civilisation, came from the peculiar atomic structure of metals, which caused them to yield instead of break under strain. Unlike the salts characteristic of inorganic chemistry, with their chessboard pattern of positive and negative atoms and the "fusing" of negative atoms in the fibres of organic chemistry, metals were composed of all negative atoms, with nothing to bind them together except a kind of atmosphere of unattached electrons. Sir Lawrence explained an idea he had been toying with and which had not yet been submitted to criticism for measuring the amount of strain which metals would stand before the atoms "slipped"—a calculation based on determination of the smallness of the crystals into which they had been broken. Pure metal was very soft, but when it was broken up by hammering, heating, or introducing foreign matter it became capable of resisting great strain, and, up to a point, the smaller it had been broken up the greater strain it would stand. Professor Fleure presided, and Professor Hartree thanked Sir Lawrence and the society for arranging the lecture.

Petroleum Chemistry

American Chemical Society's Symposium

By courtesy of the American Chemical Society we are able to publish abstracts of a selection of the papers presented to the Division of Petroleum Chemistry of that Society. The meeting was held at Buffalo, N.Y., on September 7-11.

A synthesis of unsaturated methyl ketones by reaction of branched-chain olefines with acetic anhydride is given by A. C. Byrns and T. F. Doumani, Union Oil of California. Zinc chloride and sulphuric acid have been found to be effective condensing agents; optimum yields of ketones are obtained with less than one mole of condensing agent per mole of reactants. The methyl octenyl ketone obtained as the principal product from di-isobutylene has been shown by ozonolysis to be 4,6,6-trimethyl heptene-3-one-2. Polymer gasoline, obtained from cracking plant gases by polymerisation with solid phosphoric acid, has been shown to be a suitable source of olefines.

A practical method for "de-ashing" residual oils resulting from distillation of crudes in the presence of sodium hydroxide has been developed by E. T. Scafe, K. F. Hayden, and V. A. Kalichevsky, Socony-Vacuum Oil Co. The oils are treated with boric acid at about 200° C. and the acid is recovered from the resulting sludge by acidification with sulphuric acid or sulphuric acid sludge.

Catalysis of Oil Oxidation

The catalytic effect of iron, copper, and lead in the bulk and dissolved form on three representative oils has been studied in detail by R. G. Larsen and F. A. Armfield, Shell Development Company, Emeryville, California. The variations in catalytic susceptibilities of the oils, as well as the variations of catalytic activities of the metals with concentration, are so great that it is concluded that no specified catalyst can be used in laboratory oxidation tests unless correspondence with engines is first well established. The catalytic effect of engines on oils was also investigated. It was found that the oil-insolubles (called crankcase catalysts) which accumulate in engine lubricants are extremely active catalysts. This catalytic activity resides in the metallic constituents, particularly the halides of iron.

"Lubricating Oil Detergency" was the subject of a paper by S. K. Talley and R. G. Larsen, also of the Shell Development Company. Four methods of evaluating detergency are described. One method involves a chromatographic procedure using lamp black, while the other three make use of centrifugal separation, filtration through an asbestos mat, and infra-red transmission, respectively, to evaluate the degree of dis-

persion of oil-oxidation products. All show useful correlation, within limits, with engine experience on detergency and, in addition, are useful tools in examining the detergent aspects of lubricating oils.

Hydrogen Solubility

The solubility of hydrogen in *n*-butane, examined by E. E. Nelson and W. S. Bonnell, Gulf Research and Development Company, Pittsburgh, was determined at temperatures of 23.9°, 82.2°, and 115.6° C., and at pressures up to 100 atm. At pressures below 30 atm, solubility decreases with increase in temperature; from 30 to 40 atm, temperature has very little effect on solubility; and above 40 atm, solubility increases with increase in temperature over the temperature range investigated. At concentrations of hydrogen above 3 mole per cent., the shapes of the P-T bubble-point curves derived from the solubility data suggest the existence of a region of isobaric retrograde condensation at temperatures far below the critical region of the mixtures. Data reported by Kay for the system hydrogen-naphtha show a similar phase behaviour, and it is believed that the measurements on hydrogen-*n*-butane constitute additional evidence in support of Kay's suggestion that this may be a characteristic property of a general class of such mixtures.

The surface tensions of the liquids in equilibrium with vapour have been determined by C. F. Weinaug and D. L. Katz, University of Michigan, for the methane-propane system over the range of 15° to 90° C. and 40 to 1500 lb./sq. in. The capillary rise and drop volume methods were used in a glass-windowed equilibrium cell. Differences in results between these methods were explained by the high rates of drop formation in the drop volume method. A formula was developed which reproduces the methane-propane data within 0.1 dyne/cm. Research indicates that liquids in the entire critical region have very low surface tensions.

A method for the control of sucrose used as a tracer in the determination of connate water in drilling mud is described by E. P. Rittershausen and R. J. DeGray, Socony-Vacuum Oil Co. Sucrose from any other source, and also any material yielding *d*-glucose on inversion, may be similarly analysed. The colorimetric method employs the fact that the inverted sucrose yields a red colour when heated with picric acid and sodium carbonate. All possible variations of the method have been controlled, yielding a reproducibility to within 0.13 mg. of sucrose. Permanent standards may be made with picric acid and methyl orange.

Metallurgical Section

Published the first Saturday in the month



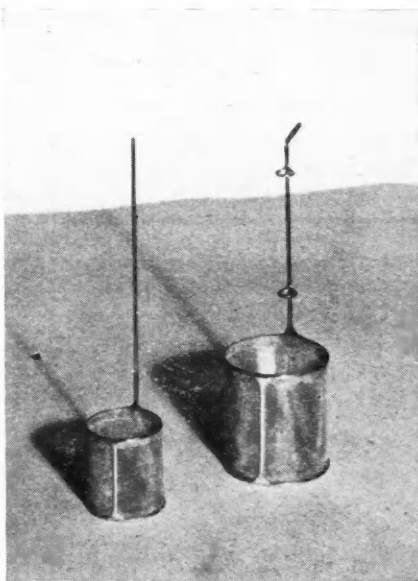
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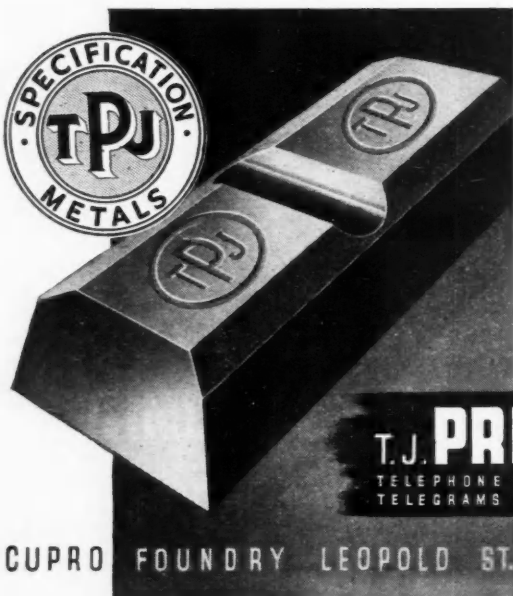
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Metallurgical Section

November 7, 1942

The Soldering of Aluminium

Advantages of the Hard and Soft Methods

By OTTO EINERL, Dr.Eng., and FREDERIC NEURATH, Ph.D.

HARD soldering as applied to aluminium and its alloys is a process that has many advantages and is particularly applicable to the manufacture of thin-walled and small-sized articles, especially those which are mass produced. The working process is similar to that for the hard soldering of brass and copper. To shorten the working time a compressed oxygen blowpipe is also often used for aluminium. This procedure represents the transition between welding and soldering.

Hard Soldering Qualities

The advantage of hard soldering of aluminium compared to welding lies largely in the saving of time, because the hard soldered seam is smoother and requires less touching up. This is especially important where overlap joints are required, or where jointing by welding is too difficult in special circumstances, as when thick and thin pieces are to be connected, or when aluminium is to be joined to other metals. By hard soldering good tensile strength and corrosion resistance of the seams are obtained, but unfortunately hard soldering is not applicable to some of the widely used heat-treated wrought alloys, because the working temperature is too high, and the improved mechanical properties gained by heat treatment are lost in the subsequent reheating for soldering. For this reason this kind of jointing should be avoided in the case of Dural, if no other than high melting solders are available; otherwise a low tensile strength and poor corrosion resistance of the soldered joint will result. On the other hand, alloys of the Alpac type (aluminium silicon alloys BA/40F, BA/40D and BA/40M of the British Aluminium Co.), and wrought alloys with high aluminium content and small admixtures of magnesium and silicon (all copper-free aluminium alloys) are very suitable for hard soldering. To the latter group belong the alloys used in electrical work, e.g., for overhead lines, such as alloy 51S (U.S.A.), Almasilium (Société de Duralumin, France), and Aldrey (A.E.G., Siemens-Schuckert, Vereinigte Deutsche Metallwerke, Germany).

Sheets, strips, tubes, bars and pressed parts which consist of manganese-containing aluminium-magnesium-silicon alloys are well

suited for hard soldering, as their m.p. is sufficiently high. These include the alloys BA/60A, BA/24, BA/24MS, and BA/25 of the British Aluminium Co., Anticoridal (Switzerland), Pantal (Vereinigte Leichtmetallwerke, Germany), Legal (Siemens-Schuckert) as well as the American Alloys QQ-A-331 and ASTM B 109-41 T of the Aluminium Company of America (Alcoa).

Types of Hard Solder

Solder alloys must be chosen to suit the alloy which is to be soldered. Generally, the best hard solders for aluminium alloys are themselves aluminium alloys (containing between 75 and 95 per cent. of aluminium), the m.p. of which must be below the m.p. of the aluminium alloys to be soldered. The usual solder alloys for aluminium are mostly of the following types:—

- (1) Silicon-aluminium alloys:
 - (a) 95 per cent. Al, 5 per cent. Si; sp. gr. 2.65, m.p. 610° C., tensile strength 8.9 tons/sq. in.
 - (b) 87 per cent. Al, 13 per cent. Si; sp. gr. 2.65, m.p. 570° C., tensile strength 10.11 tons/sq. in.
 - (c) 75 per cent. Al, 9 per cent. Si; 9 per cent. Sn, 3 per cent. Cu, 3 per cent. Cd, 1 per cent. Ni (Ger. P. 464.275).
- (2) Copper-aluminium alloys:
 - 8.12 per cent. Cu, balance aluminium; sp. gr. 2.90, melting range 540-620° C., tensile strength 7.11 tons/sq. in.
- (3) Copper-tin-aluminium alloys:
 - (a) 95.5 per cent. Al, 4.5 per cent. Cu, 5 per cent. Sn; sp.gr. 2.95, m.p. 635° C., tensile strength 11 tons/sq. in.
 - (b) 87 per cent. Al, 8 per cent. Cu, 5 per cent. Sn; sp. gr. 3.05, m.p. 635° C., tensile strength 12½ tons/sq. in.
- (4) Zinc-aluminium-silver alloys:
 - 93 per cent. Zn, 5 per cent. Al, 2 per cent. Ag (with good corrosion resistance).
- (5) Zinc-aluminium-copper alloys:
 - (a) 80 per cent. Zn, 12 per cent. Al, 8 per cent. Cu; m.p. 402° C., tensile strength 13 tons/sq. in.
 - (b) 60 per cent. Zn, 30 per cent. Al, 2 per cent. Cu, 3 per cent. Cd; m.p. 405° C., tensile strength 12 tons/sq. in.
- (6) Zinc-aluminium-zirconium alloys:
 - 90 per cent. Zn, 9 per cent. Al, 0.9

- per cent. Si plus Fe, 0.1 per cent. Zr (Ger. P. 560,281; Brenna 1931).
- (7) Zinc-silver-zirconium alloys:
95 per cent. Zn, 4.75 per cent. Ag,
0.2 per cent. Fe, 0.05 per cent. Zr
(Ger. P. 560,281; Brenna 1931).

Magnesium-containing, as well as nickel/manganese-containing aluminium alloys are in use, and these solder alloys often contain an addition of titanium to effect a grain refinement of the soldered joint, or an addition of 0.1 per cent., Na or Li, to assist in removing the oxide film. The commercial alloys for hard soldering resemble brass solders in shape, and they are on the market as wire, grain, or brazing solder, and as tube solder with flux filling, etc., according to their special applications.

Working Method

The result of the hard soldering of aluminium depends on how far it is possible to remove the invisible oxide film from the surface of the aluminium alloy. As in welding, it is first of all necessary to clean the surface of the metal thoroughly. The removal of the oxide film is brought about by means of fluxes composed of chlorides, fluorides and bisulphates of the alkaline and alkaline earth metals (Eimerl and Neurath, *THE CHEMICAL AGE*, April 4 and May 2, 1942, pp. 181, 235). By adding lithium chloride or lithium fluoride the m.p. of these salt mixtures can nearly always be so far lowered that the m.p. of the flux is considerably below that of the solder, which itself must have a lower m.p. than the aluminium alloy to be soldered.

The heating media are the soldering lamp, the gas blow pipe, and for speed, the low-pressure welding apparatus. The heat is produced by burning gas, acetylene, hydrogen, or liquid fuel. Generally, however, preference is given to a town-gas oxygen flame, not an oxy-acetylene flame, the heat of which is too great. But recently low-pressure gauges working with only 2 lb. pressure have been developed and are on the market for acetylene welding apparatus to be used in aluminium soldering. The reason for this is easily understood, as it is a primary principle in the hard soldering of aluminium that

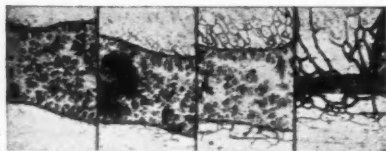


Fig. 1. (l. to r.). Diffusion of the solder into the aluminium.

first the flux, and afterwards the aluminium solder, have to become liquid, but never the aluminium alloy which is to be soldered.

It is, however, advisable to preheat the aluminium parts which are to be soldered. For thin sheets and similar articles it is best to apply the flux as a paste mixed with butyl alcohol or petroleum jelly with an addition of ammonium chloride, or better, trimethylenamine hydrochloride, and to fix it with a wire brush.

A newly developed technique for light-gauge aluminium parts is furnace brazing. Mass-produced parts, such as radiator cores, small parts for wireless sets, etc., are assembled, fluxed, and placed in electric furnaces, which can be regulated to the necessary temperature, so that the filler material, consisting of an aluminium-base solder and a flux, can melt, but not the aluminium parts to be soldered. This method gives neat meniscus joints, which require no finishing. The cost is very low, because the whole furnace can be filled with assembled parts and the raising and lowering of the temperature is kept within a limited range.

For thick sheets, and especially for cast-

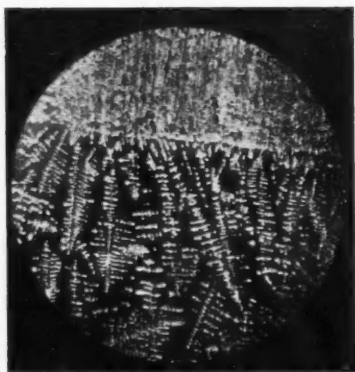


Fig. 2. Soldered aluminium. Solder: zinc base solder with cadmium.

ings, the most effective method of applying the flux is to add it on the hot end of a solder stick, which is melted up, or to dip the heated end of a solder stick into the dry powder and melt up the tuft which then adheres. Perfect hard soldering requires the practice, skill and experience of a craftsman. When a temperature approaching that necessary for soldering is reached, the flux melts first, and dissolves the film on the surface of the metal almost instantaneously. Soon afterwards the aluminium solder melts, and its contact with the clean oxide-free surface of the object is no further impeded. The contact between the liquid solder and the solid parts of the aluminium alloy which are to be soldered initiates a diffusion of the alloy components of the solder into the aluminium

which is to be soldered, and under the influence of continued heat treatment the joint becomes more and more uniform. Under the microscope it can be seen that the boundaries between solder and soldered material gradually disappear, while the solder diffuses into the surface crystals and penetrates along the existing grain boundaries, thus producing a new solid structural joint (Fig. 1).

Thus it is clear that the solder alloy and the alloy to be soldered must be compatible with each other so as to make the formation of a new alloy possible. That is to say, the alloy forming the joint must in its composition be neither brittle nor inclined to

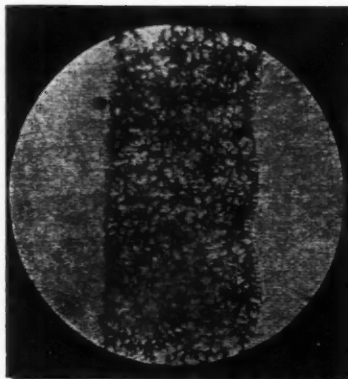


Fig. 3. Soldered aluminium. Solder: aluminium base solder.

become disintegrated by corrosion. Furthermore, the electric potentials of the solder and the aluminium alloy must not be too far apart, otherwise premature corrosion will be facilitated. If the hard solder does not immediately and easily combine with the aluminium alloy, it is advisable to help with a knife blade, or a clean wire brush, until the parts to be joined are equally moistened, whereupon a uniformly quick diffusion can begin, thus effecting a good binding on all points of contact (Figs. 2, 3).

Easiest to handle are the silicon-containing aluminium solders, and where the composition of the aluminium alloy makes their use possible, they are always the best. On completion of the soldering operation it is essential to remove all traces of flux. This can be done by brushing vigorously with hot water or by using a steam jet. Hard soldered joints made thus can be regarded as almost completely corrosion-resistant. In their behaviour they resemble aluminium and its alloys, but their colour is rather darker, especially with solders that are rich in silicon or zinc. If a suitable solder is

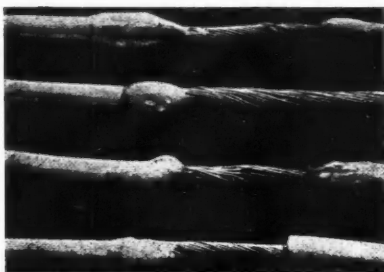


Fig. 4. Copper cable connected with aluminium wire by hard soldering.

applied, and the soldering well done, the tensile tests are sure to be satisfactory.

It is also possible to join aluminium with other metals, such as copper, brass, and iron, by means of hard soldering. Fig. 4 shows a strand of copper cable connected with aluminium wire by this means.

For this purpose silver solder is used, although its m.p. is almost as high as that of aluminium, if not higher. A suitable silver solder has the following compositions: 50 per cent. Ag, 16 per cent. Cu, 16 per cent. Zn, 18 per cent. Cd, m.p. of 620°C . and flow point of 637°C . The procedure, under application of flux, is as follows.

The soldering begins on the copper wire, on which the silver solder runs well. The aluminium wire is then brought near, and as soon as the silver solder touches the aluminium a highly liquid alloy results, which joins easily with the aluminium. Joining of sheet aluminium in the same way is not possible, because the dissolving capacity is too great for aluminium. The soldering of thicker brass sheets with sheets of aluminium is, however, carried out much more easily. It is best to apply the silver solder to the brass sheet first, and to cover it with a thin layer which runs freely and thus can be attached to the aluminium sheet (Figs. 5, 6).

The soldering of aluminium to iron is possible for both wire and sheets. The iron is first coated with a very thin layer of a good antimony-free tin-lead solder, after which the solder residues must be carefully removed. It is now possible, with pure aluminium wire and alkali-halide-containing fluxes, to obtain a good binding between the solder and the aluminium: an aluminium-tin-lead alloy is thus formed at the solder seam, the tensile strength of which improves as the aluminium content increases. It is, therefore, advisable to remove as much tinning solder as possible from the iron before soldering the aluminium to it.

Soft Soldering of Aluminium

For the purpose of soft soldering (better, low-temperature soldering) of aluminium, solders which are more or less based on low-

melting-point tin and zinc-containing alloys, and which contain additions of aluminium, cadmium, or calcium are used. The advantage which is supposed to be gained by lower working temperatures as compared with hard soldering, is amply counteracted by the fact that the fluxes used for lower temperatures do not remove the film of oxides so thoroughly as the hard-soldering fluxes working at higher temperatures. The soft soldering of aluminium is used for connection work in electrical engineering, e.g., for condensers and cables and for repairing faulty aluminium castings. The soldered joints are not moisture-resistant and, therefore, a moisture protection must be provided for joints such as those on cables not afterwards covered with an insulating mass. This is best done with a paint or varnish.

The American Bureau of Standards has recommended the use of the following lead-free soft solders for aluminium alloys:

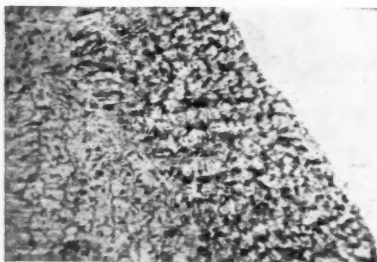


Fig. 5. Transition from silver solder to brass sheet.

S.N. 1: 78 per cent. Sn, 8 per cent. Zn, 9 per cent. Al, with an addition of 5 per cent. Cd.; S.N. 2: 69 per cent. Sn, 26 per cent. Zn, 2.5 per cent. Al, with an addition of 2.5 per cent. P.; S.N. 3: 86 per cent. Sn, 9 per cent. Zn, 5 per cent. Al, with an addition of 0.25 per cent. P.; S.N. 4: as No. 3, but without addition of phosphorus. The addition of phosphorus is to prevent the formation of a film of tin oxide on the solder and is not designed to have any effect on the soldering itself. Solders for soft soldering of aluminium with approximately the following compositions are on the market: 50-75 per cent. Sn, 25-50 per cent. Zn, 2-3 per cent. Cu, 0.4-1 per cent. Pb, and up to 0.5 per cent. Al. Fluxes for these soft solders consist largely of zinc chloride, ammonium chloride, and resin, or of a solution of 20 per cent. resin in 75 per cent. methylated spirit with an addition of 5 per cent. lactic acid (2-hydroxy-propionic acid, m.p. 18°C ., b.p. 122°C). It is also possible to use a mixture of resin with d-mannitol (d-mannite, $\text{CH}_2\text{OH} - (\text{CHOH})_4 - \text{CH}_2\text{OH}$; m.p. 166°C . b.p. 295°C).

The American Welding Society Journal

(August, 1937, p. 37) surveys the cadmium-containing soft solders for aluminium, which belong to three groups, as follows:—

(1) Tin-cadmium alloys: 89 per cent. Sn, 11 per cent. Cd.

(2) Zinc-Cadmium alloys: (a) 75 per cent. Zn, 25 per cent. Cd (German prize, 1923, with zinc chloride containing flux); (b) 60 per cent. Zn, 40 per cent. Cd (Murrough, *Electrician*, 1936, a friction solder, no flux required); (c) 75 per cent. Zn, 20 per cent. Cd, 5 per cent. Al.

(3) Tin-cadmium-zinc alloys: (a) 55 per cent. Sn, 20 per cent. Cd, 25 per cent. Zn; (b) 46 per cent. Sn, 18 per cent. Cd, 27 per cent. Zn, 9 per cent. Pb. (for soldering magnesium-containing aluminium alloys).

(4) British Patent, 424,370, of 1934, suggests the following method: In soldering aluminium alloys the parts should first be brushed or rubbed with a solder having an m.p. of $200\text{--}250^{\circ}\text{C}$. (e.g., 42 per cent. Zn, 58 per cent. Cd), then a solder having an m.p. of $400\text{--}500^{\circ}\text{C}$. should be applied (e.g., 80 per cent. Sn, 17 per cent. Zn, 3 per cent. Al).

For the repair of defective aluminium castings, low-melting tin-zinc alloys with an addition of calcium are recommended, which do not melt totally at the applied temperature of $250\text{--}350^{\circ}\text{C}$., but only form a pasty mass which can easily be spread with a knife blade and worked into the defect, where they stiffen in the required shape. For these solders fluxes are not needed, and a good connection with the object is best obtained by rubbing the first solder lots in with a rotating card wire brush, after which a further lot of solder can be added.

The following alloys are recommended, in order of melting points: (a) m.p. $300\text{--}400^{\circ}\text{C}$. 57 per cent. Zn, 25 per cent. Al, 2 per cent. Cu, 2 per cent. Sn, 4 per cent. Pb, 10 per

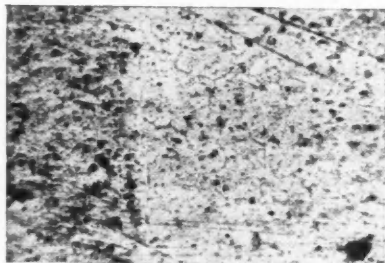


Fig. 6. Transition from silver solder to aluminium sheet.

cent. Ca.; (b) m.p. $300\text{--}350^{\circ}\text{C}$.; 82.5 per cent. Cd, 15 per cent. Zn, 2 per cent. Ag, 0.5 per cent. Zr; (c) m.p. $250\text{--}300^{\circ}\text{C}$.; 42 per cent. Zn, 12 per cent. Al, 1 per cent. Cu, 26 per cent. Sn, 8 per cent. Pb, 12 per cent. Ca; (d) m.p. $200\text{--}250^{\circ}\text{C}$.; 90 per cent. Sn, 7.5 per

cent. Zn, 0.1 per cent. Zr; (e) m.p. 150-200° C.; 15 per cent. Zn, 5 per cent. Al, 40 per cent. Sn, 30 per cent. Pb, 10 per cent. Ca.

All the soft solders have the disadvantage of a very low tensile strength (2-4 tons/sq. in.) and a low corrosion resistance, which can generally be tested by dipping the soldered joint into salt solution, which affects the soldered parts after a short time, and eventually destroys them.

Corrosion Tests

(1) *Cold Water Test* (Nicolai, *Elektrotechn. Z.*, 1913, 34, 131). The soldered joint is placed in water. If bubbles rise to the surface within two days (hydrogen formation) the joint is not suited to withstand moist air for more than a few months.

(2) *Salt Spray Test* (*Proc. A.S.T.M.*, 1918, 18, 1, 237). This test, first described by Capp, approaches a practical corrosion test more closely. The test, as conducted at the American Bureau of Standards, is made in a box of artificial stone or of glass, with a glass cover, and a glass support for the samples. The construction is indicated in Fig. 7. The box is inclined so that the drops of solution collecting on the cover will run down instead of dripping on to the samples. A 20 per cent. solution (by weight) of common salt, filtered if necessary, is used with an air pressure of about 6 or 7 lb./sq. in., which produces a very fine mist from the salt solution. The baffle plate prevents the salt spray from blowing directly against the test pieces. No definite statement can be made concerning the relative corrosion resistance except in a general way. A sample showing corrosion in less than 24 hours should be regarded as unsatisfactory, while a life of two or three days indicates that the soldered joints can safely be used under moderate conditions of exposure.

(3) *Calcium Chloride Immersion Test* (Edwards and Dix, *The Aluminium Industry*, McGraw Hill, New York, 1930). A 5 per cent. calcium chloride solution is used for this test, which is very severe and equivalent to the salt spray test, but slower. Alternatively, a solution containing 1 per cent. of calcium chloride and 1 per cent. of sodium chloride can be used, but solders do not exhibit the same behaviour in both solutions. Soldered joints made with a solder containing 60 per cent. Sn and 40 per cent. Zn fell apart completely in the 5 per cent. calcium chloride solution after 100 days. Aluminium joints

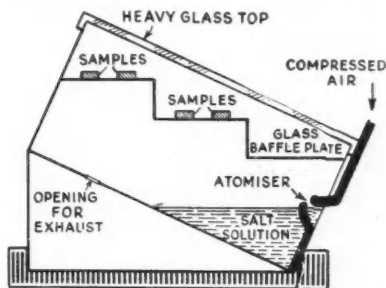


Fig. 7. Salt Spray Corrosion Test.

soldered with zinc base solders withstood the calcium chloride test better.

(4) *Salt Solution Boiling Test* (Bauer and Masing, *Die Korrosion von Nichtmetallen*, Leipzig, 1938, p. 258). A 3 per cent. solution of common salt is brought to the boiling point and the lap joints ($\frac{1}{4}$ in. overlap) of the aluminium sheets are then immersed. Poor solders fail in about 8 hours, good solders in 48 to 72 hours.

SILVER-LEAD ALLOY

An improved silver-lead alloy bearing for heavy loads and high speeds is now being used by P. R. Mallory & Co., Inc., of Indianapolis. The silver serves as a substitute for tin and copper, which are now in short supply in America. The difficulty with previous bearings of the sort was to get the lead to alloy with the silver. The two are almost immiscible in the molten state, the silver taking up only 2 to 3 per cent. of the lead whereas a good bearing requires more lead. By calling into aid the technique of powder metallurgy the inventors have obviated this difficulty. Powdered silver and lead, mixed in the right proportions and of prescribed particle size, are compressed and heated without melting. The result is a dense homogeneous material having excellent alloying qualities. A modification of the method is to electroplate the lead with silver, and then to compress and sinter.

CORED SOLDER STANDARD

In view of the recent steps that have been taken to effect economy in the preparation of tin used in solders, a war emergency revision slip has been issued to B.S. 441, which specifies that the grade of solders used in cored solders should conform to one of the five grades covered by the War Emergency British Standard No. 219. In order to provide for the possibility of even lower tin solders being used a qualification is included to state that by agreement other alloys may be employed. It is, of course, intended that such alloys shall be alloys lower in tin than those covered by B.S. 219. The opportunity has also been taken to extend the scope of the specification to include multicore solders and to modify the requirements as to the composition of the resin used for filling the core. Copies of this amendment slip may be obtained from the British Standards Institution, gratis, on receipt of a stamped addressed envelope.

Welding Copper Plant

Various Methods and their Chemical Application

THOUGH copper is one of the most useful metals in the chemical and allied industries, in the form of sheet and pipe, its use has to a certain extent been retarded by the fact that it has not been easy to make a really sound joint by welding when the usual commercial grades of copper are employed. On the other hand it is known that a good weld in copper will prove entirely satisfactory if properly deoxidised plate and welding rod are used. It is also known that the welded joint offers a smooth joint which is as easily cleaned as the plate itself, and a joint that is as fully resistant to corrosion as the copper base metal. Bronze-welded joints are equally as efficient but copper joints are preferred where a colour match is desired.

The difficulties of utilising ordinary tough pitch copper of normal composition as a base material in welding operations have long been recognised, and a type of copper has been developed which is manufactured by a process entirely different from that ordinarily employed in copper refining, and is claimed to be eminently suitable for welding.

The Welding Blowpipe

In order to combat the rapidity with which heat would be conducted away from the weld, most copper work should be thoroughly preheated before welding. For small scale work it will probably be sufficient to heat the metal thoroughly for about 12 in. on either side of the weld. This is done with the welding blowpipe before welding, a larger nozzle being inserted in the blowpipe head for this purpose. For large work on copper thicker than $\frac{1}{4}$ in., it is advisable to employ a second man with a blowpipe on the opposite side of the weld, the second blowpipe being continually moved from side to side for about 12 in. on each side of the weld. For very large work two or three nozzle blowpipes may be used for heating, although one blowpipe employed judiciously is usually quite sufficient. The surface of the weld metal should be built up above the surface of the surrounding metal. After the weld has been completed it should be heated to a dull red and thoroughly hammered with a planishing hammer until flat. Copper has very little strength at high temperature, so that care should be taken not to make the metal too hot for hammering, and the hammering should not be continued when the metal has cooled down too much, otherwise it will be made brittle.

There are, of course, various copper-base alloys in commercial use, and in most of these an excess of oxygen or too great an

excess of acetylene should be avoided, a slightly reducing flame being most suitable. The size of the flame depends largely on the thickness of the metal to be welded, and the welding tip should be somewhat larger than would be used for steel of the same thickness. During welding the work should be shielded from draughts, as these cause the weld to be brittle. Only bright wire or strips of sheets of the same alloy, usually pickled bright in nitric acid, should be used for welding rods. The weld should be completed in one place before starting in at another, otherwise the surface of the weld at different elevations will oxidise in cooling, and when remelted at these points to complete the weld the oxide will cause blow-holes in the weld.

In general the weld should not be carried out continuously from one end of the seam to the other, but should be built up of solid metal free from oxide, bringing the weld well above the surface as progress is made. Concentrating the flame for any length of time on one spot must be avoided in order not to burn the metal. Fewer precautions are necessary for mechanical welds (i.e., welds for strength only) than for welds that are to resist corrosion. When making corrosion-resistant welds both the welding rods and the surfaces of the metal to be welded should be pickled bright in nitric acid, or made entirely free from oxide or scale in some other manner.

Silver Soldering

The silver soldering process offers a valuable supplement to bronze-welding for work where the relatively low heat necessary for bronze-welding is still too high for making the desired joint, or where the corrosive agent that will come in contact with the joint may attack bronze. As for the physical properties of the silver solders generally used, there is some variation depending on the exact composition. For applying silver solder by the oxy-acetylene process the procedure is simple and in many cases offers certain advantages over other methods. As in all soldering operations the parts to be joined must be thoroughly cleaned, either chemically or mechanically. Since any soldering operation is a surface phenomenon, the necessary penetration and "sweating" of the solder to the base metal can take place only on clean metal. Joint edges and surfaces should be smooth and fit tightly. The merest film of solder is sufficient in a tight joint to effect a strong bond, and any greater thickness of silver solder is wasteful.

Flux is also essential for the best results. It dissolves any oxides that may form on

the surface of the metal when heated, prevents atmospheric oxidation by covering the heated part, and assists the "sweating" action of the solder. There are several good fluxes available commercially, or a saturated solution of borax can be used, brushed on to the parts to be joined as well as the soldering wire.

The oxy-acetylene flame produced by a small-sized blowpipe tip will be found most suitable for light work. For heavier work, such as making sweat-type joints in large diameter piping, a larger flame—one that will heat the work rapidly—is, of course, desirable. For very light objects the smallest available tip is advisable, or in some instances an acetylene-air flame will be found best. In general, a soft oxy-acetylene flame of a size to heat the work rapidly and thoroughly is recommended.

After it is fluxed the work is heated to the proper temperature, care being taken not to overheat the base metal, the flame is removed, and the solder then applied to the joint. It will melt and flow by capillary attraction, to all parts that have been properly cleaned and fluxed. The knack of heating to the right temperature is quickly developed with practice, and the flame must be applied only to the work, never to the wire or to the solder in the joint itself. Silver solder flows so evenly under the oxy-acetylene flame that it penetrates quickly

and deeply into all parts of the joint, leaving no pinholes.

One of the most prominent uses of the oxy-acetylene flame for silver-soldering work is in the chemical and process industries. In this work resistance to corrosion is, of course, an important feature of all equipment. Of particular interest is the joining of non-ferrous piping by means of sweat-type joints. In a recently-installed plant copper piping of diameters ranging up to 6 in. was joined by the use of sweat-type fittings. Silver solder was used for many of these joints where maximum corrosion problems were met at temperatures lower than the melting-point of the silver solder used. Ordinary solders could not be used because of their low melting points and their inability to resist corrosion. For working temperatures higher than silver-solder would stand bronze was used as the bonding agent, and for maximum temperatures copper fusion welds were adopted.

Another interesting job was the fabrication of eleven large copper process vessels for chemical use. The seams in these tanks are said to be longer than any seams previously silver-soldered by the oxy-acetylene process. Some means of making the copper plate edges meet in line instead of the usual lap-type joint was necessary for this work, and the plate edges were therefore machine-bevelled to 45°.

Molybdenum Steel

Heat Treatment of High-Speed Steel

THE monthly Bulletin of the Ministry of Labour has widened its scope and is now known as *Production and Engineering Bulletin*. The first issue in the new form (dated October, 1942) has as its principal article a description of the heat treatment of molybdenum high-speed steel. Such steel, of the 6-6 type, has for some time been in service for a large range of applications, and has demonstrated its capability of replacing 18 per cent. tungsten steel in a considerable number of these; and practical experience has shown that 6-6 molybdenum steel, if handled with care, decarburises during heat treatment little, if any, more than the 18 per cent. tungsten type.

Careful temperature control, especially in the forging process, is essential, and care in preheating is as important as with high-tungsten steel. The article contains full instructions on these points, as well as requisite information on annealing and hardening. Tempering, also, is a process noted as requiring careful observation of the proper conditions, if the risk of cracking is to be avoided. Brazing and butt-welding to medium carbon steel may be successfully carried out provided that precautions are taken similar to those customary in dealing with 18 per cent. tungsten high-speed steel.

Chrome-X

Product to Replace Ferrochrome

RECENT imports of chrome ore from South Africa into Canada have been utilised in the manufacture of "Chrome-X," which replaces ferrochrome. By the use of this product, steel in the low chromium range can be made in the open hearth. The process of M. J. Udy employed, consists essentially in replacing FeO in the solid solution by MgO, as described in a recent note by G. S. Preller, M.Sc., of the South African Department of Commerce and Industries. The silicate gangue takes up CaO when the ore is fused with lime, and this substitution liberates MgO, which, in turn, replaces FeO in the chromite. Finally, there is a complete decomposition of the chromite. With control of lime addition, $MgO \cdot Cr_2O_3$ —magnesium chromite—results, which crystallises as an altered chromite of higher specific gravity than the original chromite of the ore, and can be readily concentrated from the silicate portion by water concentration. This concentrate may have a chromium to iron ratio of eight to one or more and, after acid treatment, as much as fifty to one. To produce ferrochromium of 70 per cent. grade this concentrate is simply used to sweeten a portion of the low-ratio ore to a three to one ratio or better, and then smelted by standard methods.

Personal Notes

SIR DAVID MILNE-WATSON has been re-elected president of the Fuel Luncheon Club for the coming year.

MR. H. R. ATTON has relinquished his position as assistant managing director of Richard Thomas and Co., steel and tinplate manufacturers, and has ceased to be a member of the board.

MR. W. B. BROWN, H.M. Senior Inspector of Mines, of Western Hill, Durham, has been awarded the G. C. Greenwell Medal for his paper on "The Production of Carbon Monoxide in Compressed Air Ranges," which was read before the North of England Institute of Mining Engineers last April.

DR. JAMES S. RANKIN has been appointed by the Governors of the Royal Technical College, Glasgow, to the Freeland Professorship of Physics in succession to PROFESSOR D. B. MACQUISTAN, who has retired for health reasons. Dr. Rankin has been on the teaching staff of the College since 1919.

Obituary

MR. J. S. BONNYMAN, of T. R. Bonnyman, Son and Co., chemical manufacturers, Dalmarnock, Glasgow, died in Glasgow on October 27.

MR. F. CALDWELL KER, who died on October 27 at West Kilbride, Ayrshire, aged 59, was a director of John Paterson & Co., Ltd., chemical manufacturers, Glasgow.

DR. JOHN ARTHUR WILSON, who died in New York on September 10, aged 52, was a well-known consulting chemist in America, and a specialist in leather chemistry. He studied at New York University and in this country at the University of Leeds, returning to Leeds in 1915-16 as honorary research assistant at the Procter International Research Laboratory. In 1931 he won the William H. Nichols Medal of the A.C.S. (New York Section) for outstanding achievement in colloid chemistry.

PROFESSOR JOHN NORMAN COLLIE, D.Sc., LL.D., F.R.S., F.R.S.E., died at Sligachan, Skye, on November 1, aged 83. He was Emeritus Professor of Organic Chemistry at University College, London, having held the Chair in 1902-28. He was also director of the chemical laboratories there in 1913-28, having succeeded Ramsay in that post. In addition to being a brilliant chemist, noted for his work on the effect of high-potential electric discharges on gases at low temperatures, he was also a famous mountaineer, being an ex-president of the Alpine Club, and wrote on climbing in the Himalayas and the Rockies. He was a Fellow, and had been vice-president, of the Royal Geographical Society.

New Control Orders

Export of Chemicals

Under the Export of Goods (Control) (No. 41) Order, 1942 (S. R. & O. 1942, No. 2185) which comes into force on November 16, control is extended to cover, among other commodities, additional chemicals. The Order also withdraws the concession under which oils and foodstuffs could be exported without licence to certain specified Colonies. Licences will, in future, be required to export, to all destinations, bismuth compounds and preparations thereof; nicotinamide; sulphadiazine and sulphamethazine, transparent cellulose wrappings and articles containing 50 per cent. or more by weight of these materials; tin compounds; and zinc compounds.

Sulphur

The Minister of Supply has issued the Control of Sulphur (No. 2) Order, 1942, increasing maximum prices of sulphur ground from crude sulphur by £1 per ton. The Order (S. R. & O. 1942, No. 2203) came into force on October 30.

He has also made the Control of Sulphur (No. 3) Order, 1942, prohibiting the use of sulphur or any material containing sulphur in any of the processes in the wool textile industry or the wool hosiery industry known as "stoving," except under licence. Applications (in duplicate) for licences should be submitted, as appropriate, either to the Director of Wool Textile Production, Wool Control, Bradford, or to the Directorate of Civilian Hosiery, Fast Court, West Walk, Leicester. Applications will be considered by the Sulphuric Acid Control only in cases where a recommendation is made by one of the above-mentioned authorities, either of whom will provide the requisite forms. The Order (S. R. & O. 1942, No. 2206) came into force on November 6.

Coal Tar Products

The Control of Coal Tar (No. 2) Order, 1942 (S. R. & O. 1942, No. 2136, price 3d.), is similar in substance to S. R. & O. 1942, No. 732, which it supersedes, but in addition to minor alterations in definition the following new provisions have been included. (1) The treatment, use and blending of coal tar products by distillers and importers will be subject to licence; (2) An article has been incorporated empowering the seizure and sale of coal tar and coal tar products, in the event of suspected contravention of the Order; (3) The application of the Control of Coal Tar (No. 2) Order, 1942, will extend to Northern Ireland. The Order came into force on November 1, and applications for licences should be made to the Coal Tar Controller, Quebec House, Quebec Street, Leeds, 1.

General News

The Ministry of Food announces that there will be no change in the existing prices of oils and fats allocated to primary wholesalers and large trade users for the four weeks ending November 28.

Manufacturing chemists have been buying horse chestnuts for 8s. per cwt. through the Red Cross. From this raw material they are making anti-fire foam as well as glucose. The protein residue is used for cattle food.

A cheque for £1000, from the sale of salvaged metal toothpaste tubes, was handed recently to Lord Iliffe, chairman of the Red Cross and St. John Appeal Fund, on behalf of the dentifrice manufacturers of Great Britain.

Hundreds of electric welders and those interested in the craft have been shown a series of films entitled "The Inside of Arc Welding" in Glasgow. The films, which were shown under the auspices of the Ministry of Supply, were in Technicolor.

The Government is to take longer-distance road haulage traffic under its control in order to maintain the industry in an efficient condition as an essential reserve of transport. The measure is intended to ensure that, despite the restricted supplies of rubber and fuel, a sufficient number of vehicles will be available in time of need.

Direction No. 1 has been issued by the Minister of Supply under the Control of Rubber (No. 16) Order, providing for the disposal and acquisition of transmission belting without licence to users producing a valid certificate to the effect that the belting is urgently required to keep machinery in operation. The Direction came into force on November 2.

After ten months' working of the Anglo-American Combined Raw Materials Board, Sir Clive Baillieu has given a favourable report of the Board's activities in arranging for the best use of raw materials available to the United Nations. An example of its work was in its making possible the shipment from America of all available supplies of aero grade balsa wood, which had helped Britain to carry out the programme for building the "Mosquito" all-wood bomber.

The presidential address to the Institution of Civil Engineers, delivered by Sir John Thornycroft on Tuesday, dealt with the subject of Engineering in Agriculture. The application of engineering to drainage, to soil erosion, and to the provision of machinery for the land was discussed in detail; the importance of continued research was stressed; and some important suggestions were made as to the provision of cheap electric power in farming districts.

From Week to Week

Another chart for the detection of toxic gases in industry is now obtainable. This is No. 2, for hydrogen cyanide vapour, and is printed on benzidine-copper-acetate paper. The new edition (revised price, 2s. 6d.) is obtainable from H.M. Stationery Office or through booksellers.

The Control of Iron and Steel (No. 25) (Scrap) Order, 1942, which came into force on November 3, provides that no person may treat, use or consume tramway rails, except as part of a railway or tramway track or as scrap for re-melting, unless licenced by the Minister of Supply.

About 260 names are added, by the Trading with the Enemy (Specified Persons) (Amendment) (No. 17) Order, 1942 (S.R. & O. 1942, No. 2154), to the list of those with whom trade of any kind is illegal. The list includes S.A. pour la Fabrication de Magnesum, 12 Av. de la Gare, Lausanne. Among deletions are Productos Quimicos Schering and Pharmaceutical Importers S.A., both of Havana.

Foreign News

Sodium propionate is being used successfully in Canada to prevent mould formation in bread, according to *Foreign Commerce Weekly*.

New tung plantations to the extent of 500 acres are to be added this year to the area already planted in Nyasaland, which in December, 1941, amounted to 5881 acres.

Wolfram production in the Argentine is expected to progress rapidly, now that assistance is being given to the San Luis minefield by the Government and the National Bank.

A factory for processing seaweed to be used for the manufacture of cloth is reported to have been established by the Germans at Jatren, in Southern Norway. The waste products are to be used for the manufacture of cattle fodder.

Cement is the latest German industry to be driven eastwards as the result of the R.A.F. bombing. According to the *Bertingske Tidende*, of Copenhagen, several ovens from Western German factories have been shifted to Bialystok, in Poland, and a complete factory is to follow.

All U.S. industries using alloy steel, copper, carbon, and aluminium, must now estimate their requirements in advance, and a central bureau will then allot to each factory whatever quantity it thinks fit, without appeal. This is the cardinal decision in the new American plan which at last attempts to grapple seriously with the problem of raw material control.

A new aluminium plant, it is announced, is to be built at Santander, Spain, by the Sociedad General de Aluminio, and is designed to produce 10,000 tons of aluminium per annum.

Manufacture of vanillin from sulphite lye will be attempted for the first time in Germany by Ligrowa G.m.b.H., a company recently established at Mannheim with a capital of 1,200,000 marks.

The Canadian Controller of Metals has announced the discovery of a deposit of molybdenum at Preissas, in North-Western Quebec. The deposit is reported to be at least 400 ft. long and 200 ft. deep, and to possess an average width of 30 ft. It is intended to proceed with its exploitation immediately.

A method has been found of extracting crude tartar from the "spent wash" of wine stills in the Hex River valley, Transvaal, according to reports from South Africa. By building a dam, it was possible to divert this material into a furnace, where it could be evaporated for further processing. Previously, 20,000 gallons of this waste had been escaping daily and polluting the soil.

Forthcoming Events

The annual general meeting of the Leeds area section of the **Institute of Chemistry** will be held, at 6.30 p.m., on **November 9**, at the University, Leeds. Dr. J. J. Fox will open a discussion on "Policy and the Chemist."

A meeting of the **Institution of Chemical Engineers** in conjunction with the **Chemical Engineering Group** of the Society of Chemical Industry, will be held in the rooms of the Geological Society, Burlington House, Piccadilly, W.1, at 2.30 p.m., on **November 10**, when a paper on "A New Method of Graphical Representation and its Application to Vapour-Liquid Equilibria" will be presented by Mr. A. L. Bloomfield, B.A., B.Sc.

A meeting of the London Section of the **Society of Glass Technology** will take place at 8 Leicester Street, Leicester Square, W.C.2, at 6.30 p.m., on **November 11**. Two papers concerning Fuel Economy will be presented by Messrs. L. E. Norton and W. A. Moorshead.

A meeting of the **Institute of Fuel** will be held in the Connaught Rooms, Great Queen Street, W.C.2, at 2.30 p.m., on **November 12**, when Dr. G. E. Foxwell will present a paper entitled "The Provision of Smokeless Fuel for Post-War Reconstruction."

A meeting of the **Pharmaceutical Society of Great Britain** will be held in the Small Hall of Friends House, Euston Road, London, N.W.1, at 2.30 p.m., on **November 12**, when Professor J. C. Drummond, D.Sc., F.I.C., will give a lecture on "Nutrition."

There will be a meeting of the Scottish section of the **Oil and Colour Chemists' Association** jointly with that of the **Society of Dyers and Colourists**, at the St. Enoch Hotel, Glasgow, on **November 13**, at 6.30 p.m., when Dr. W. A. Wood will speak on "Applications of X-rays in Industry, with reference to the Examination of Pigments."

The South Wales Section of the **Society of Chemical Industry** will meet jointly with the **Institute of Chemistry** and the **Chemical Society**, at 3.15 p.m., on **November 14**, at the Physics and Chemistry Theatre, Cathays Park, Cardiff, when Professor H. W. Melville will give a lecture on "The Mechanism of Polymerisation."

The inaugural meeting of the Midland branch of the **Institute of Fuel** will be held in the Grand Hotel, Birmingham, at 2.30 p.m., on **November 14**, when a discussion dealing with "The Battle of Fuel in Industry: How is it going?" will be opened by Dr. E. W. Smith, C.B.E.

A conference to discuss "The Chemist in Industry," arranged by the **Association of Scientific Workers** (London area; chemical industries sub-committee), will be held in the Caxton Hall, Westminster, S.W.1, on **November 15**. There will be two sessions, one at 11 a.m., and a second at 2.30 p.m.

There will be a meeting of the London Section of the **Society of Chemical Industry** in the Chemical Society's Rooms, Burlington House, W.1, at 2.30 p.m., on **November 17**. An address on "Co-ordination of Chemical Societies in the United Kingdom" will be given by Mr. H. V. Potter.

The 218th ordinary meeting of the **Society of Glass Technology** will be held at "Elmfield," Northumberland Road, Sheffield, on **November 18**. Two sessions will be held, the first at 11 a.m. and the second at 2 p.m. A series of papers will be read by Mr. T. H. Wang and Professor W. E. S. Turner, and the meeting will end with a symposium on "The Effect of Arsenic in Glass."

At a meeting of the Birmingham Section of the **Institute of Chemistry**, to be held in the Chamber of Commerce, Birmingham, at 5.30 p.m., on **November 18**, Dr. J. M. Webster will speak on "Forensic Science."

The annual general meeting of the London and South-Eastern Counties Section of the **Institute of Chemistry** will be held at 4 p.m., on **November 18**, at the Institute of Chemistry. An address on "Adulteration Past and Present" will be given by Dr. J. R. Nicholls, F.I.C.

The Sir William Bragg Memorial Lecture of the **Chemical Society** will take place in the lecture theatre of the Royal Institution, Albemarle Street, W.1, at 2.30 p.m., on **November 19**, when Professor J. D. Bernal will give some account of the life and work of Sir William Bragg.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

JOHN DALE, LTD. (formerly John Dale Metal Containers, Ltd.), London, E.C. (M., 7/11/42.) October 9, £770 mortgage, to Trustees of late Jno. Dale Carr; charged on 2 to 12 (even) Brunswick Park Road, New Southgate. *£5346. September 3, 1941.

BRITISH CELANESE, LTD. Torquay. (M., 7/11/42.) October 14, £35,000 debenture stock, part of an amount already registered. *£2,786,481. December 31, 1941.

Receiverships

SPENCER, SON AND PARTNERS, LTD. (R., 7/11/42.) D. A. Mathieson, of 103 Cannon Street, E.C.4, was appointed receiver October 16, under powers contained in debenture dated April 27, 1942.

Company News

Cerebos, Ltd., have declared an interim dividend of 10 per cent. (same).

B. Laporte, Ltd., have announced an interim dividend of 5 per cent. (same).

Lightalloys, Ltd., announce a net profit for the year to June, 1942, of £39,794 (£31,542).

Lawes Chemical Co., Ltd., have declared a dividend of 6 per cent. (same) for the year to June 30.

Thos. W. Ward, Ltd., have declared a final dividend of 7½ per cent. (same), making 11½ per cent., less tax, for the year.

Thompson Bros. (Bilston), Ltd., propose a final dividend of 7½ per cent., making 15 per cent. (same). There is also to be a bonus of 7½ per cent. (against 5 per cent.).

William Neill and Son (St. Helens), Ltd., have announced a trading profit of £89,388, and a final dividend of 3½d. per share, making 5d. per share.

W. and H. M. Goulding, Ltd., announce a net profit, for the year ended June 30, of £31,315 (£36,093), and have declared a final dividend of 3 per cent., making 6 per cent. (same).

John Dale, Ltd., announce a net trading profit for 1941 of £97,226 (£33,880). A meeting of preference shareholders is announced to consider a resolution increasing the borrowing powers from £75,000 to £200,000.

The Imperial Smelting Corporation has arranged to exchange its holding in **National Fertilizers, Ltd.**, for 160,000 ordinary shares in Fisons, Ltd. These shares will carry certain restrictions as to dividends for a period of four years, but thereafter will rank *pari passu* in all respects with the existing ordinary stock of Fisons. This move will have the effect of completely merging National Fertilizers into Fisons. National Fertilizers was formed in 1934 by the Imperial Smelting Corporation and Fisons for manufacturing and distributing fertilisers in the West of England, and since that time its activities have greatly increased.

New Companies Registered

Shupol, Ltd. (376,884).—Private company. Capital: £500 in 500 shares of £1 each. Manufacturers of and dealers in metal, furniture, boot and other polishes and creams, oils, chemicals, patent and other medicines, chemical goods and materials, soaps, etc. Subscriber: Gordon Murray, 59 Shirley Road, Roath Park, Cardiff. Solicitors: Gilbert Robertson & Co., Cardiff

P. R. T. Laboratories, Ltd. (376,931).—Private company. Capital: £1000 in 1000 shares of £1 each. To promote and undertake scientific research and investigation of all kinds, to develop scientific, chemical, metallurgical, and other inventions and processes (British or foreign). Subscribers: F. H. Lister, S. Russell. Registered office: Wadsworth Road, Perivale, Greenford, Middlesex.

Chemical and Allied Stocks and Shares

FIRM and active conditions have prevailed in Stock Exchange markets, sentiment having been aided by favourable views of war developments. In accordance with the prevailing trend at the time of writing, shares of chemical and kindred companies have been firm, and where changed, moderate gains were shown on balance. Imperial Chemical were slightly higher at 35s. 9d. as were the 7 per cent. preference units at 34s. 7½d. Lever & Unilever were maintained at 30s. 6d., and Borax Consolidated at 34s. British Aluminium remained in favour and further improved from 48s. 6d. to 49s. 3d., while British Oxygen were 74s. compared with 73s. 3d. a week ago. Awaiting the forthcoming dividend announcement, Imperial Smelting moved up from 12s. 9d. to 13s. 9d. Fisons transferred at 41s. 3d. Imperial Smelting is exchanging its holding in National Fertilizers for 160,000 ordinary shares in Fisons. Elsewhere, General Refractories made the slightly higher price of 12s. 7½d. Cerebos were firm at £9½ aided

by the maintained interim dividend of 10 per cent. and by hopes that the total dividend may be kept on a 40 per cent. basis.

Despite the cautious remarks in the annual statement, the deferred units of Wall Paper Manufacturers were higher, having further improved on balance from 30s. 3d. to 31s. 6d. at the time of writing. British Match eased slightly to 36s. 9d. but are now "ex" the interim dividend. British Drug Houses were firm around their par value of 20s., and Greeff-Chemicals Holdings 5s. units were 5s. 7½d. Goodlass Wall 10s. ordinary showed a number of dealings and held their recent improvement to 12s. 6d., while in other directions business around 16s. was recorded in Burt Boulton and at 23s. in Morgan Crucible 5 per cent. second preference. British Thermostat changed hands at 16s. at one time, British Glues 4s. shares up to 6s. 6d., and the participating preference up to close on 30s. Among smaller-priced shares, William Blythe 3s. ordinary were dealt in at 6s. 1½d. at one time, British Industrial Plastics around 4s. 4½d., and Erinoid 5s. shares around 9s. 6d.

Barry & Staines were little changed at 35s. 6d., awaiting the interim dividend. Nairn & Greenwich moved up from 55s. to 57s. 6d. On the other hand, United Molasses were 29s. 10½d. "ex" the interim dividend, and Triplex Glass had an easier appearance at 28s. 7½d. The units of the Distillers Co. continued to be favoured, and further improved from 81s. 3d. to 82s. 3d., the view having gained ground in the market that although the dividend may very well continue to be limited to 16½ per cent. during the war, higher rates of dividend may be possible afterwards. The rise in many industrial shares in evidence recently is based mainly on market views as to post-war prospects, but it is, of course, impossible to forecast the position that may exist during the change-over from war conditions to peace-time production. Among other gains, Turner & Newall were higher at 75s. 6d., as were Murex at 98s. 9d., and Amalgamated Metal at 15s. 3d. Elsewhere, Allied Ironfounders were 37s. 9d., having shown a further small gain, pending announcement of the interim dividend. Tube Investments have had a firm appearance at 90s. 3d. in advance of the dividend statement, and Stewarts & Lloyds were 49s. 9d. Guest Keen were 30s. and there were small gains in a number of other iron and steel shares.

Further gains were also shown in textile issues, including Calico Printers and Bradford Dyers. Courtaulds were higher at 43s. 6d., and British Celanese have rallied to 16s. 3d. Among other securities, British Plaster Board were active but unchanged at 27s. 6d., and Associated Cement improved to 56s. 10½d. Boots Drug were 38s. 3d., and

Sangers 19s. 9d. Higher prices ruled for "Shell" and other leading oil shares.

British Chemical Prices

Market Reports

OST sections of the general chemicals market report a steady movement during the past week with values showing little change of any importance. Contract deliveries have been well maintained and new business for home account, if not substantial, has been of reasonable dimensions. As for some time past, the volume of inquiry for export has been greater than actual bookings. There have been no outstanding features during the week in the soda products section: chlorate, yellow prussiate, and bichromate of soda are items for which supplies are tight but elsewhere a fairly active demand is being dealt with. All grades of acetic acid have moved on a good scale and the demand for oxalic acid has been strong. The supply position of tartaric acid is reported to be better. No price changes fall to be recorded for the lead oxides, and formaldehyde and barium chloride remain unchanged at recent levels. The coal-tar products section is still awaiting an announcement in regard to price developments for xylol and naphthas, for which products a fair amount of inquiry is reported. The demand for cresylic acid both for home account and for shipment continues on substantial lines and phenol is also an active section.

MANCHESTER.—Generally firm price conditions remain a feature of the Manchester market for chemical products, though there has been little if any actual change on balance for the week. A small export business has been reported, but the bulk of the moderate volume of new buying has been on home trade account. With regard to contract commitments, these are fairly extensive still and, on the whole, requisitions are said to be coming forward fairly satisfactorily, the soda and ammonia products being absorbed in steady quantities and a ready market continuing for the potash materials. Most classes of tar products are in good demand.

GLASGOW.—In the Scottish heavy chemical trade there was no change during the past week for home business. Export inquiries are still rather restricted. Prices remain very firm, and in a few instances there has been a slight advance.

Price Changes

Sulphur.—Per ton, for quantities of not less than 4 tons: unground, unsieved, and ungraded, £14 10s., ex store; ground, but not sieved, £15 5s.; ground and sieved, £16 to £17 10s., according to mesh. Controlled prices.

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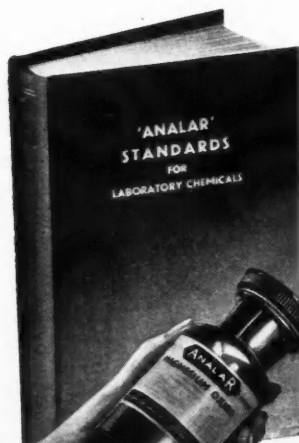
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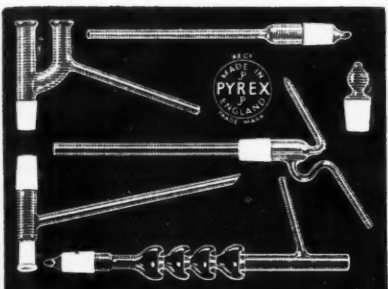
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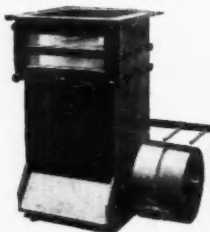
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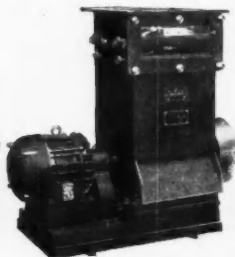
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